CLIMATE CHAGE IMPACTS OF RURAL SOCIETIES: STAKEHOLDERS PERCEPTIONS AND ADAPTATION STRATEGIES IN BUENOS AIRES, ARGENTINA

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CLIMATE CHANGE IMPACTS ON RURAL SOCIETIES: STAKEHOLDERS PERCEPTIONS AND ADAPTATION STRATEGIES IN BUENOS AIRES, ARGENTINA.

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Abstract — Heavily dependent on agriculture, Argentinean stakeholders must prepare to adapt their activities to a different climate. However, the country does not have an agricultural adaptation plan. A space of joint discussion and participatory planning among farmers, scientific researchers, firm managers and government representatives can increase the preparedness to cope with the impacts of climate change. This research uses individual and group interviews to identify perceptions about climate change and possible adaptation strategies suitable for different types of stakeholders of the district of Balcarce. Relatively homogeneous groups of stakeholders perceive an array of weather changes and identify a range of adaptation strategies. This rich set of perceptions and strategies constitute an excellent starting point to define priorities in research and in policy making to implement national, regional, or firm-level adaptation strategies. Genetic techniques, specific scientific knowledge and land-use planning are viewed as promising sources of adaptation and coordination mechanisms. One common request from stakeholders is the coordination between, and within, public and private organizations. Effective adaptation strategies require the implementation multi-level governance and policy integration. However, these integrations will generate benefits in any type of future climate.

Key words : Climate change, stakeholders, perceptions, adaptation strategies

Resumen — Altamente dependientes de la agricultura, los actores Argentinos deben prepararse para adaptar sus actividades a un clima diferente. A pesar de esto, el país no cuenta con una planificación agrícola de largo plazo. Un espacio de discusión y planificación conjunta entre productores, investigadores científicos, gerentes de empresas y funcionarios gubernamentales podría incrementar el grado de preparación para amortiguar los impactos del cambio climático. Este trabajo utiliza entrevistas individuales y grupales para relevar la percepción al cambio climático e identificar posibles estrategias de adaptación apropiadas para distintos tipos de actores del distrito de Balcarce. Grupos relativamente homogéneos de actores perciben una diversidad de cambios climáticos e identifican un amplio rango de posibles estrategias de adaptación. Esta diversidad constituye un excelente punto de partida para definir prioridades de investigación y de generación de políticas para implementar estrategias de adaptación nacionales, regionales o individuales. Las tecnologías genéticas, el conocimiento científico específico y los planes de ordenamiento territorial son vistos como fuentes promisorias de mecanismos de coordinación y adaptación. Un pedido común de los actores es la coordinación entre y dentro de las instituciones públicas y privadas. Una efectiva política de adaptación requiere de la coordinación de múltiples niveles de gobierno y de la integración de medidas de política. Sin embargo, tales integraciones generarán beneficios ante cualquier escenario climático futuro.

Palabras claves : Cambio climático, actores, percepciones, estrategias de adaptación.

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INTRODUCTION

Today's world poses new, unexpected threats to societies. Climate change is an example of such threats with the potential to affect agriculture and societies. In recent decades, Argentina's agriculture has benefited from favorable weather with a substantial increase in annual precipitations, especially near the western border of the Pampas region which contributed to move westward the boundary of rainfeed agriculture (Berbery, Doyle, and Barros 2006). However, a different set of climatic variables has the potential to reduce production substantially. As one of the main exporters of agricultural commodities, Argentina is heavily dependent on its agriculture. The economic dependence on agriculture is particularly stressed for medium to small communities of the Pampas. For the south of the Buenos Aires province, agriculture contributes with 30% of the regional gross product, but for specific areas this figure rises up to a 68% (Centro Regional Buenos Aires Sur 2009). Across the Pampas, agricultural systems are highly sensitive to changes in climate. Analyzing the impact of a reduction in annual rainfall, Podesta et al. (2009) showed that the possibility of economic losses increases from 2- to 4-fold for the main crops in marginal subregions, if no adaptation strategies are adopted.

Despite the importance of climate for the local economy, recent changes in Argentina's agriculture and political scenario suggest that day-to-day concerns prevent long term actions to mitigate the impacts of climate change. Technological innovations and substantial economies of scale have created optimal conditions for the soybean area to grow rapidly, increasing the dependence on weather conditions that favor the soybean crop. Also, the increase of short-term cash leases and the spread of direct tilling, requiring an intense use of herbicides, create concerns about the sustainability of current production systems. Furthermore, the country's agriculture does not count with well developed insurance instruments causing that weather variations impact with full force on farms' income. Unlike developed countries, Argentina has no price stabilization or support program, and other forms of price/revenue insurance such as agricultural insurance or futures markets are not well developed. The country does provide emergency assistance to producers struck by climatic disasters by postponing the payment obligations of certain taxes and loans granted by public banks. However, more comprehensive insurance products are scarce and expensive. At most, producers acquire hail insurance, but the use of multiperil coverage or futures and options markets is very uncommon (Martinez Melo, Mosciaro, and Fangio 2002; Bertolasi 2005).

Finally, in recent decades, political tensions between Argentina's main farmer associations and the federal government have been common. These tensions peaked in March 2008 when the main national farmers associations united in protest for the increase in the tax rates that Argentina levies on the export of agricultural commodities. The conflict was solved, but afterwards relationships between farmer associations and the government hardened and dialogue diminished to its minimum.

The situation described suggests that a space of joint discussion and participatory planning among farmers, firm managers and government representatives could increase the preparedness to cope with the impacts of climate change on agriculture and on related communities. Therefore, the objective of this article is to identify the perceptions about climate change held by different stakeholders of the district of Balcarce, in the province of Buenos Aires, Argentina, and to design, in a participatory setting, adaptation strategies suitable for each type of actor involved. Balcarce is a typical agricultural district influenced by the homonymous medium-size city. This district counts with a diversity of actors that provides a fertile ground for participatory research in agriculture and weather related topics, and is also one of the study sites of the CLARIS-LPB project developing several related studies about climate change impacts. Conclusions of this study will contribute to increase the stakeholders' knowledge of both their own vulnerabilities and other stakeholders' vulnerabilities and adaptation necessities.

Also, considering farmers' views and feedbacks is suggested to improve the understanding of the adoption and dissemination of agronomic innovations (Franzel et al. 2001). Therefore, the strategies suggested here will fit stakeholders' activities better than strategies designed by central development agencies.

Our research contributes to the existing literature in several ways. First, this research will allow understanding the perceptions held by farmers, firm managers, government officials, and scientific researchers about climate change. Because perceptions play a critical role in decision making, understanding stakeholders' perceptions is key to foresee their management decisions under a different climatic scenario. Given the importance of these stakeholders, their decisions will shape the societies of the south of the Buenos Aires province. Second, our results will provide a set of adaptation strategies to climate change suitable to local producers, private companies, governments and research institutions. The aim of these strategies will be to increase the sustainability of the systems and to promote local development. Finally, results of this study will guide hypothesis formulation and further research work. Knowing the vulnerabilities and adaptation needs of different stakeholders will orient the assessment of alternative adaptation strategies in terms of their productive and economic convenience, as well as in terms of their adoption potential. Research needs identified will be demand-driven as they come from a direct discussion with potential adopters.

The rest of the paper is organized as follows, the next section details the methodology employed, describing the study area and the procedures used during the interviews. The last two sections present, respectively, the results and the conclusions of the study.

METHODOLOGY

The proposed study is interdisciplinary in nature. The research is a contribution to the CLARIS-LPB project, which is part of the Seventh Framework Programme and develops climate change impact evaluations and designs adaptation strategies. The consortium that develops the CLARIS-LPB project is formed by 19 European and Latin-American research and extension institutions and includes specialists in climate, agronomy, hydrology, sociology, and anthropology among others. For the south of the Buenos Aires province, the AGRITERRIS laboratory leads the impact assessments of the CLARIS-LPB project. The laboratory, part of the National Institute of Agricultural Technology (INTA), develops research, extension and education activities to promote the development of rural communities using participatory planning and the communities' local knowledge.

Study Area

The region known as Humid Pampa is a densely populated savanna occupying most of the Buenos Aires province and important portions of the Santa Fe, Córdoba and Entre Rios provinces. With dark loessic topsoils and regular rainfall patterns, the Pampas is one of the most important cereal- and oilseed-producing regions of the world (Solbrig and Viglizzo 1999). Balcarce is a typical district of the Pampas region covering 412.000 hectares, with a population of 42.000 people. In this district, 27% of the adults have high school or higher education degrees, and 21% of the labor force is employed in the farming/livestock sector (Instituto Nacional de Estadísticas y Censos 2001). Main crops grown in the district are wheat, soybean, sunflower and corn, as well as cattle raising.

Stakeholders Interviews

In order to achieve the objective of this study a team of researchers with expertise in agronomy, sociology and economics conducts individual and focus group interviews about climate change

impacts. The combination of individual semi-structured interviews and focus groups has important advantages. On one hand, individual interviews allow a deep exploration of highly specific or politically sensitive topics making it possible to collect information that would not likely surfaced in the focus groups. Also, interviews held without time constraints and on a relaxed atmosphere favor a fluid discussion and foster the expression of individuals that tend to be overridden by more dominant participants in a group environment. On the other hand, in focus groups participants develop a range of proposal and arguments to sustain them that result in richness not often found in individual interviews. Smithson (2000) suggests that opinions stated in the group should not be interpreted as previously formed or static thoughts that participants expressed in the group, rather these opinions are constructed in the environment provided by the group. While these opinions reflect the participants' values and beliefs, they are shaped by the group interactions. However, the group's collective message may deviate from participants' individual views. The stakeholders interviewed and their main features are presented in Table 1.

Table 1. Stakeholders Interviewed

Institution/Type	Occupation	experience (years)
Farmer A	Farmer	25
Farmer B	Farmer/consultant	20
FOCUS GROUP I (2 farmers)	Small scale farmers	25 - 40
FOCUS GROUP II (4 farmers)	Medium/large scale farmers	6 – 35
FOCUS GROUP III (4 extension professionals)	Extension agents	3 – 43
Commodity Futures Exchange	Futures exchange executive	5
Insurance Firm	Crop Insurance firm executive	17
Municipal Government	Government official	< 1
Research & Extension Institution	INTA/FCA, researcher in plant eco-physiology	>20
Research & Extension Institution	INTA/FCA, researcher in ecology	>20

FCA: Department of Agronomy, National University of Mar del Plata.

These stakeholders are selected because they, or the institutions they belong to, will experience the impacts of climate change, either directly or indirectly. The selected stakeholders exhibit different degrees of vulnerabilities to climatic variations. Farmers are directly impacted by climatic changes, while futures exchanges and insurance companies sell services to farmers, thus their demand for products can be affected, either positively or negatively, by climatic variations. Finally, the city government and research and extension institutions are not directly impacted, but the services demanded to them can change, either in type or in quantity, as climate changes.

The interviews have two major objectives. The first goal is to understand the perceptions about climate change impacts held by each type of stakeholder. The second goal is to provide a space of discussion in which stakeholders can identify adaptation strategies, but also communicate their needs and limitations to implement those strategies. Stakeholders interviewed are homogeneous in terms of social and cultural attributes, all but one reside in the South of the Buenos Aires province, and all but one are male. The farmers interviewed both individually and in the focus group, are homogeneous regarding their farming operations, as all grow cereals and oilseeds to be sold internationally. These operations also have similar structures of capital and labor is provided mainly by the producers and their families. Farming operations differ in the number of cultivated hectares ranging from 200 hectares for the smallest operation to 1300 hectares for the largest one. Nevertheless, focus groups are formed to preserve homogeneity within groups.

The official of the city government has less than one year in office, but has a long working relationship with farmers, agricultural non-government organizations (NGO's), and input dealers. The researchers participating in this study specialize in ecology and plant eco-physiology, hold doctorates from international universities, and have a long record of scientific and extension publications. The participating extension agents provide technical advice to a variety of local producers. Finally, executives from a nation-wide insurance company and from a futures and options exchange also participate in the present study. These last firms have been selling agricultural insurance instruments for more than 85 years; thus they have a thorough knowledge of weather and farming activities in the area of study.

Individual and group interviews are held by two or more scientists at the stakeholder's offices. Individual and group interviews last at least 45 minutes and two hours, respectively. Once the groups are assembled, scientists explained the purpose of the overall project and that of the focus groups, in particular. During the sessions, one of the researchers guided and animated the discussions, while the others tape recorded the dialogues, took handwritten notes and kept track of the participations by each individual. Participants were provided with refreshments and snack food. The same list of topical questions is used to guide individual and group interviews, but a great deal of flexibility was allowed as the goal was to know the diversity of perceptions and adaptation strategies. The questions covered the following main topics: (i) perceived changes in local weather; (ii) causes of changes (i.e., anthropic versus natural); (iii) what can societies do to revert/mitigate the observed changes; (iv) how perceived changes can affect the interviewees' productive activities; (v) how they can adapt to such weather changes, and (vi) what are the interactions with, or the demands to, other research and government institutions, as well as to private firms.

After each session, the tapes were transcribed and checked by all the researchers that participated in the interviews. Personal names were removed or replaced by pseudonyms. The transcripts were then analyzed independently by each scientist trying to identify, systematize, and drawn general conclusions about perceptions and adaptations. Once the individual analysis was finished, group sessions were held where scientist compare the information in the transcripts, identify conflicting conclusions and resolving them through further analysis until a consensus was reached. Comparative tables summarizing and comparing the expressions of each stakeholder were constructed and checked for consistency. During the research process, special care was used to capture the whole range of perceptions and adaptations expressed by the stakeholders, rather than converging on a few visions.

RESULTS

Results are presented and analyzed following the 6 topics listed above in order to maintain the analysis organized.

Perceived Changes: all stakeholders interviewed perceive a range of changes in local weather patterns in recent years (Table 2). While this range includes from temperature variations to the lost of coastal lands, the majority of the interviewees note a warming process, more frequent droughts and a higher variability of water available for crops (i.e., more frequent droughts combined with more torrential rains). Regarding warming, one farmer, two focus groups, and one researcher noted milder winters and one extension agent reported recent episodes of vegetable seedlings being lost to thermal shocks. Concerns about changes in water availability are also evident among local stakeholders. Concerns about a higher frequency of droughts and changes in water availability for crops surfaced in 5 individual and in 3 focus group interviews, respectively. It is worth noting that the district of Balcarce suffered a severe drought during 2009, and it is likely that that event is affecting stakeholders' perception. Tversky and Kahneman (1974) document that decision makers assign a higher probability of occurrence to episodes observed recently.

Causes of Observed Changes: Most stakeholders attribute changes to a combination of natural and anthropic causes, and are unsure about the weights of each effect. In seven interviews, stakeholders perceive changes coming from a combination of causes, anthropic-only causes are described in three interviews, and natural-only causes are perceived in one focus group within which participants hold diverse opinions about the causes (Table 2).

Researchers and insurance firm executive tended to be skeptical of anthropic drivers of climate change. The specialist in eco-physiology observed no significant trends in crop yields attributable to climate changes. This researcher believes that observed changes in temperature are part of the random variations of any variable. Similarly, the insurance executive comment that similar extreme events have been observed 60 or 70 years ago and that much of the current climate concerns are caused by the popular media. These opinions are probably caused by the fact that these interviewees are used to analyze long time series of yield and weather data and, as a consequence, have a broader perspective on climatic variations than other stakeholders.

Table 2. Stakeholders' Perceptions and Adaptation Summary

Institution/Type	Main Weather Changes	Antrophic/Natural Causes
Farmer A	• drought • hydric variability	• combination: anthropic actions & natural cycles – unsure about weights
Farmer B	• warming/milder winters • frequent water stresses • spring frosts	• all anthrophic: consumism, populat. growth, non-rational farming
FOCUS GROUP I (2 farmers)	• warming/milder winters • hydric variability	• combination: anthropic actions & natural cycles – unsure about weights
FOCUS GROUP II (4 farmers)	• rainfall decrease • milder winters	• all anthropic: carbon comsupt & agriculture
	/// No change just cycles	/// all natural
FOCUS GROUP III (4 Extension professionals)	• drought • warming • hydric variability • lost of coastal lands	• combination: anthropic actions & natural cycles – unsure about weights
Futures Exchange Executive	• warming • sea & river pollution	• combination: anthropic actions & natural cycles – unsure about weights
Insurance Firm Executive	• warming • less defined seasons • more frosts & hail	• combination: anthropic & natural causes – No clear effects of climate change today
Municipal Government Official	• drought • desertification	• all anthropic: contaminating activities affecting climate
Researcher in eco-physiology	• warmer summers	• combination: anthropic & natural causes – changes are normal fluctuations
Researcher in ecology	• warming/milder winters	• combination: anthropic actions & natural cycles – unsure about weights

Hydric variability: means that the content of moisture in soil and in air fluctuates more through the year than it used to.
/// indicates different opinions within the focus group.

How to Revert/Mitigate Changes: When asked what can societies do to stop or mitigate the observed changes, most interviewees propose changing consumption habits, reducing carbon

dependence and making agriculture more environmentally friendly. One focus group and one researcher suggest conserving biodiversity and natural ecosystems. These interviewees point out that it is now common to observe crops grown on the highway side. However, highway sides play important ecosystemic roles, such as to provide refugee for wild animals and plants, and that farming these spots reduces biodiversity further.

Effects of Changes on Farming: Interviewees describe several mechanisms by which weather variations impact their activities. Producers tend to perceive drought as the most negative phenomenon. Interviewees mention that drought is the phenomenon with the capacity to cause the largest reduction in crop yields. Producers perceive negative changes better than positive ones. Farmer B describes how warming in late spring reduces kernel filling, negatively affecting wheat yields. However, none of the farmers mention that warmer springs and/or summers positively contribute to soybean yields, as explained by the eco-physiology researcher. While all interview participants are well aware of climate impacts, none of them mention weather as the main factor for deciding land allocation among crops or livestock activities. Producers agree that land allocation is based on economic benefits and ease of marketing of products.

Adaptation Strategies: Interviewees, across all backgrounds, suggest genetic-related adaptation strategies (Table 3). This adaptation includes using native species, developing genotypes with tolerance to specific events, and improving the match of genotypes with environments. Several producers relate the role of biotechnology to adapt to future climate by accounting the expansion of soybean brought about, in part, by the development of the glyphosate resistance gene. Farmer B recommends researching wild wheat genotypes that grow better in warm environments, yielding more. Farmer A notes that native grass species withstand prolonged floodings better than non native grasses, albeit producing less. Therefore, this producer believes the use of native species can constitute a natural adaptation to a more variable rainfall regime.

The specialist in eco-physiology also stresses the potential of biotechnology to generate adaptations to a changing climate. This interviewee remarks that the study of the interactions between plants and environment can help us understanding new adaptation mechanisms. Similarly, the ecology researcher suggests territorial development plans to promote an environmentally friendly agriculture. However, these plans also include the preservation of wild areas which play the role of gene reserves. For the case of climate change where future conditions are uncertain, such genes preserve adaptation flexibilities that can be useful in a different, yet unknown, environment.

Several farmers propose sustainable agricultural practices, and government and INTA's representatives propose the implementation of land use planning (LUP) (Table 3). This holistic plans articulate research institutions with different government offices and local NGO's to generate guidelines and policy measures that orient the development of local communities, industries and agriculture in an environmentally friendly way. It is worth mentioning that sustainable agricultural practices are, at least in part, considered in territorial development plans.

Producers and the insurance firm executive note the advantages of better using available weather information. Producers mention the variety and quantity of weather information available today. Some farmers explain that weather reports do not lead them to plant different crops, but they do use forecasts to adjust the way the crop is conducted. For instance, if a dry season is forecasted, farmers maintain a long fallow period and use direct seeding in other to maximize water availability for the crop. The insurance executive mentions the usefulness of weather radar to forecast and assess hail damages. However, the executive remarks that investments are needed in order to expand and improve the network of radars. Producers in focus group II ask for a better state-wide infrastructure for tracking and forecasting weather events.

Table 3. Suggested Adaptation Strategies and Cooperation with Other Institutions

Institution/Type	Adaptation Strategies	Cooperation / Institutions
Farmer A	• use of native species • sustainable agric.	• producers associative insurance /other producers • redesign macro policies / federal gov.
Farmer B	• improved & wild genotypes • match genotypes & environm. • less intensive agric.	• research on modern, improved genotypes / R&D institutions, private firms
FOCUS GROUP I (2 farmers)	• improved genotypes • use weather information	• better infraestructure maintenance (ej: country roads) / city gob. • redesign macro policies / federal gov. • catastrophe-triggered subsidies / federal gov.
FOCUS GROUP II (4 farmers)	• diversify production activities • use weather information • use crop insurance	• redesign macro policies / federal gov. • better infraestructure maintenance (ej: weather radars) / federal gov. • catastrophe-triggered subsidies / federal gov. • insurance instruments / private firms
FOCUS GROUP III (4 extension professionals)	• improved genotypes • sustainable agric. • territorial develop. plans • redesign leasing contracts	• pollution policies / federal gov. • implementation of LUP/ federal, city gov.
Futures Exchange Executive	• offer new commodity contracts following as commodity production grows	• policies to foster financial markets development / federal gov.
Insurance Firm Executive	• assess risk at plot level • improve database • improve weather radar network	• cooperation for developing new products /federal gov. • research to assess incident risk by plot / R&D institutions
Municipal Government Official	• promote different production activities • territorial development plans • implement social protection plans	• improve coordination and dialogue / local NGO's, farmers associations • implementation of LUP / city gov., R&D institutions
Plant eco-physiology Researcher	• study genotype by environment interactions • promote biotechnology R&D	• assemble well trained researcher teams, redesign human resource education policies / R&D institutions
Ecology Researcher	• territorial development plans • value appraisal of ecosystem services • preserve wild environments	• improve coordination among public R&D institutions / federal gov. • policies to regulate of ecosystem management / federal gov.

When asked for adaptation strategies, the futures exchange executive remarks that the exchange can launch new commodity contracts as new crops are being produced in increasingly large quantities. However, the executive discourage launching weather derivatives contracts. Despite being suggested as potential adaptations to climate change, the executive believes that economic agents in Argentina have a limited familiarity with these instruments for them to reach meaningful trading volumes.

Cooperation/Demands with Other Institutions: not surprisingly, when asked for the main areas of cooperation with or demands to other institutions, responses varied markedly by expertise groups. All, but one, of the producers ask to the federal government an adjustment in commercial and tax regulations. Producers perceive that trade regulations are too intricate

difficulting the normal selling of products. Producers also request improvements in infrastructure such as roads, drainage systems, and a wider weather radar network. Nevertheless, during the interviews farmers denote scarce training in cooperating with the local government or with research institutions. Beyond asking for policy and infrastructure improvements, it becomes evident that these interviewees do not have a fluid interaction with the city government or with researchers of the local experimental station of INTA or with the FCA.

The concern about weather tracking instruments is shared by the insurance executive who explains the benefits of this technology, but remarked that such a development can only be undertaken by the federal government. The expert also mentions that insurance products such as multiple peril instruments can not be launched without the government subsidizing the premiums. Such subsidies are needed because the actuarially fair premium is usually too high to be paid entirely by the farmer.

Extension and research personnel stress the importance of policy measures to regulate pollution and wild area management and see LUP as a vehicle to implement these regulations. Also, these interviewees suggest a better coordination between and within research institutions to define research topics and to implement efficient education programs for researchers.

Finally, the futures exchange executive remarks that the development of futures markets can be promoted by a cooperative work with policy makers to develop the appropriate policy measures. At a district level, the city government representative highlights the function of the Local Development Agency, a NGO promoting social development and environmental protection. This representative states that in addition to promoting growth, one of the main objectives of the agency is to improve the coordination and dialogue among city institutions and farmer associations.

CONCLUSIONS

The present article identifies climate change perceptions held by a cross section of stakeholders of the district of Balcarce. Perceptions are identified using semi-structured interviews and focus groups. This research also identifies a set of possible adaptation strategies and adaptation needs suggested by the stakeholders. Collectively, the interviewees combine practical and technical knowledge on agricultural and livestock production, as well as expertise in government offices and research institutions.

Results presented indicated that relatively homogeneous groups of stakeholders perceive an array of weather changes and identify a wide range of adaptation strategies. We believe that this rich set of perceptions and potential strategies constitute an excellent starting point to define research priorities and policy making to implement national, regional, or firm-level adaptation strategies. In agreement with previous adaptation studies (Hallegatte 2009), interviewees emphasized the role of genetics to develop resistant or adapted varieties that can produce in a different climate. Native and wild genotypes, biotechnology and an improved knowledge of genotype and environment interactions are seen as promising sources of adaptation mechanisms. At a district level, land-use plans are viewed as instruments that can integrate innovations, policies, and production practices in an environmentally-friendly way.

Another common request from producers, research and extension specialists, government officials and private firm executives is the coordination between, and within, public and private organizations. LUP can partially serve as instruments that bring together local institutions in a collaborative effort to promote sustainable development. However, coordination must also include national actors and multiple government levels. In this stage, it is perhaps enlightening the experience of other countries pioneering the implementation of national adaptation strategies. Biesbroek et al. (2010) reviews adaptation strategies of seven European countries

and identifies multi-level governance and policy integration as the main limitations to strategy implementation. It is recognized that adaptation cannot be implemented in isolation, and the authors provide some guidelines that can help implementing national adaptation strategies. These guidelines are, strengthening specific scientific knowledge, creating flexible mechanisms for science and policy interaction, and developing a framework for evaluating adaptation policies. It is worth noting that the suggested guidelines will generate benefits whether or not climate change actually occurs.

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